



Sleep Disturbances and Behavior Problems in Children With and Without Arthritis

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The study compared sleep disturbances and behavior problems in school-age children with and without juvenile idiopathic arthritis (JIA). Children 6-to-11 years of age, with ($n = 70$) and without ($n = 46$) JIA, and their parent participated. Parents completed questionnaires on sleep habits and behavior problems. Compared to control children, JIA children had significantly higher total sleep disturbances and higher scores on six of eight subscales. Sleep disturbances predicted externalizing behavior problems, controlling for age, medications, study group, and pain. Sleep disturbances such as, sleep disordered breathing are often overlooked or unrecognized in JIA and may contribute to behavioral problems.

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ACUTE AND CHRONIC medical conditions increase the risk of sleep disturbances in children. Sleep disturbances are associated with particular sleep disorders (e.g. sleep disordered breathing), are often co-morbid with acute and chronic illness states (e.g. arthritis, asthma), manifest during developmental transitions (e.g. childhood, adolescence), or are sometimes self-imposed because of caregiving demands. Regardless of etiology, sleep disturbances most often manifest as disrupted or fragmented sleep and as an inadequate amount of sleep. There is some evidence that sleep disturbances are more persistent in children with chronic conditions compared with those without chronic conditions (Sivertsen, Hysing, Elgen, Stormark, & Lunder-vold, 2009). Underlying inflammation, disease-related symptoms of pain, shortness of breath, fatigue, and side effects of medications influence sleep. Exacerbation of pain and fatigue, daytime sleepiness, missed days from school, and lower quality of life are often attributed to the underlying

chronic condition, but unrecognized and untreated sleep disturbances such as sleep disordered breathing and poor sleep hygiene may be important etiologies that are often overlooked both by clinicians and parents (Chervin, Archbold, Panahi, & Pituch, 2001; Erichsen et al., 2012; Faruqi, Khubchandani, Price, Bolyard, & Reddy, 2011). Children with chronic conditions such as Juvenile Idiopathic Arthritis [JIA]) are vulnerable to the adverse consequences associated with unrecognized sleep disturbances including behavioral problems, neurocognitive decrements, and poorer quality of life.

Juvenile idiopathic arthritis (JIA) is an inflammatory chronic disease with unknown etiology. It is one of the most common pediatric rheumatologic chronic conditions with an estimated prevalence of 300,000 children in the United States (Sacks, Helmick, Luo, Ilowite, & Bowyer, 2007). JIA is a disease that can persist into adulthood and result in significant long-term morbidity including physical disability (Minden, Niewerth, Listing, & Zink, 2002; Selvaag et al., 2006). Disease severity varies in JIA with unpredictable episodes of inactive disease and active disease, including

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joint inflammation, pain, stiffness, and limited mobility. In conjunction with these symptoms, sleep disturbances including frequent limb movements, snoring, difficulty falling asleep, nighttime awakenings, and daytime sleepiness are found in children with arthritis (Abad, Sarinas, & Guillemineault, 2008; Butbul Aviel et al., 2011; Passarelli et al., 2006; Ward et al., 2008).

Sleep disturbances in children are associated with adverse health outcomes including behavioral problems, e.g., mood swings, hyperactivity, aggression, anxiety, difficulty with social and emotional functioning, poor quality of life, and school absenteeism (Gregory & Wiggs, 2013; Gruber, Cassoff, Frenette, Wiebe, & Carrier, 2012; Hysing, Elgen, Gillberg, & Lundervold, 2009; Simola, Liukkonen, Pitkaranta, Pirinen, & Aronen, 2012; Touchette et al., 2012; Touchette et al., 2009; Witcher et al., 2012). Decreased night time sleep duration, longer sleep onset time, variability in bedtimes, poor sleep hygiene, and more night awakenings have been associated both with internalizing behavior problems (e.g. anxiety and depressed mood), and externalizing behavior problems (e.g. aggression, impulsivity, and hyperactivity) (Alfano, Ginsburg, & Kingery, 2007; Biggs, Lushington, van den Heuvel, Martin, & Kennedy, 2011; Hudson, Gradisar, Gamble, Schniering, & Rebelo, 2009; Simola et al., 2012). In a community sample of 8 year-olds, parent reported bedtime refusal was associated with increased child-reported anxiety (Gregory, Rijdsdijk, Dahl, McGuffin, & Eley, 2006). Recent studies have shown that persistent sleep disturbances in early childhood predict later internalizing and externalizing behavior problems in middle school and adolescence (Forbes et al., 2008; Gregory, Rijdsdijk, Lau, Dahl, & Eley, 2009). Simola et al. (2012) conducted a 4-year follow-up study in 470 Finnish children; those with persistent sleep disturbances in early childhood were 16 times more likely to have aggression, anxiety, depressed mood, and social and attention problems in middle school.

Sleep disturbances in JIA have been associated with disease-related symptoms of pain (Bromberg, Gil, & Schanberg, 2012a; Schanberg, Anthony, Gil, & Maurin, 2003), and fatigue (Butbul Aviel et al., 2011; Passarelli et al., 2006; Ward et al., 2008), but findings between sleep disturbances and behavior problems have been inconsistent (Bromberg et al., 2012a; LeBovidge, Lavigne, Donenberg, & Miller, 2003). Some studies report higher rates of behavioral problems such as anxiety, depression, adjustment difficulties and mood in JIA compared to healthy peers, and others report no significant group differences (Bromberg et al., 2012a; Huygen, Kuis, & Sinnema, 2000; LeBovidge et al., 2003; Noll et al., 2000).

The purpose of this study was to describe and compare parent reported sleep disturbances and behavior problems, and to examine sleep disturbances as a predictor of behavioral problems in 6-to-11 year-old children with JIA compared to typically developing children. Based on previous studies involving children with JIA, we hypothe-

sized parents of children with JIA would report more sleep disturbance compared to parents of typically developing children. We further hypothesized that sleep disturbance would explain a significant portion of the variance in internalizing and externalizing behavior problems, after controlling for age, study group, medications, and joint pain.

Method

Participants

Approval for this study was obtained from the institutional review board. Researchers recruited a convenience sample of 70 JIA children (53 girls, 17 boys) and 46 control children (30 girls, 16 boys), totaling 116 participants, 6-to-11 years of age. In addition, parents of participating children were enrolled in this study. JIA and control parents were included in the study if they were the primary caretaker of the child and able to read and speak English. Inclusion criteria for JIA children were a diagnosis of oligoarticular or polyarticular JIA, 6 to 11 years of age, and able to read and speak English. Control children were included in the study if they were 6 to 11 years of age and able to speak and read English. Both JIA and control children were excluded if they had a psychiatric condition, ADHD, diabetes, asthma, cancer, or a disability that would interfere with neurobehavioral performance testing. Additionally, JIA children diagnosed with active systemic JIA were excluded as these children often require hospitalization. Of the 70 children with JIA, mean disease duration was 3.6 years. Within the group, 37.1% ($n = 26$) had oligoarticular disease, 57.1% ($n = 40$) had polyarticular disease, and 5.7% ($n = 4$) had inactive systemic disease. Fifty-seven percent ($n = 39$) had active arthritis, inflammation of one or more joints with swelling, limited range of motion, or tenderness, and a physician global assessment of >1 on a clinical scale of 0–10, and 45% ($n = 31$) had inactive arthritis, with no joints with inflammation and a physical global assessment of 0 on a scale of 0–10.

Measures

Children's Sleep Habits Questionnaire

Parents completed the Children's Sleep Habits Questionnaire (CSHQ) (Owens, Spirito, & McGuinn, 2000) a 45-item retrospective report that examines their child's sleep habits (bedtimes, wake times, behaviors) and whether or not they were problematic over a typical week. The CSHQ yields a total sleep disturbance score and eight subscale scores: bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night awakenings, daytime sleepiness, parasomnias, and sleep disordered breathing. Parents rate the frequency of each item on a 3-point scale ranging from "usually" (5–7 times per week) to "rarely" (0–1 times per week). Higher

scores indicate greater overall sleep disturbance. A total score greater than 41 has been established as a cutoff indicative of clinically significant sleep disturbance (Owens et al., 2000). The CSHQ has adequate internal consistency, test-retest reliability, and validity, and has been used in previous studies with JIA and healthy school-age children (Bloom et al., 2002; Owens et al., 2000; Ruperto et al., 2010). In this sample, total scores ranged from 31 to 71. Internal consistency ranged from 0.35 (parasomnias) to 0.71 (sleep duration). Reliability of the total sleep disturbance scale in this sample was $\alpha = .91$.

Child Behavior Checklist (CBCL)

Parents completed the Child Behavioral Checklist (CBCL), a 119-item retrospective report of a child's behavior over the last 6 months. The CBCL consists of eight syndrome subscales (anxious/depressed, withdrawn/depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior and aggressive behavior), and three broad band scales (externalizing problems, internalizing problems). Parents rate the frequency of each behavior on a 3-point Likert scale (0 = not true; 1 = somewhat or sometimes true; 2 = very true or often true). Raw scores are summed and converted to *T* scores. Higher scores represent more disruptive behaviors. On the broad band scales (externalizing; internalizing) *T* scores >63 are considered clinically significant. Total scores for these samples ranged between 24 and 70. The reliability and validity of the CBCL is well established in school-age children with and without chronic conditions (Achenbach, 1991; Rosen et al., 2004).

Medications

Parent's recorded children's medication type, frequency, and dosage. Medications were scored as "yes" or "no" and classified into following categories: 1) nonsteroidal anti-inflammatory drugs (NSAIDs); 2) corticosteroids; 3) disease modifying anti-rheumatic drugs (e.g., methotrexate, Arava); 4) tumor necrosis factor- α receptor inhibitors (e.g., etanercept, adalimumab, infliximab); 5) other (e.g., vitamins); and 6) none.

Pain

Pain intensity was measured with the Oucher Faces Rating Pain Scale (Beyer, Denyes, & Villarruel, 1992); a series of 6 faces that range from (0) "doesn't hurt at all" to (10) "hurts as much as you can imagine". Children placed an "X" on a face that best described their pain. Reported reliability and validity for the Oucher scale are adequate in children 3 to 12 years of age (Hockenberry et al., 1994; Beyer et al., 1992; Beyer & Aradine, 1988), and the Cronbach alpha coefficient in this sample was .91.

Statistical Analysis

Data were analyzed using SPSS for Windows version 18.0 (SPSS Inc., Chicago, Ill). Descriptive analyses were

calculated on age, sex, ethnicity, and medications to address group differences (JIA versus controls) in study variables. Unpaired *t*-test and chi-square procedures were used to examine group differences (JIA versus controls). In the entire sample the proportion of children above and below the CSHQ clinical cutoff score (>41) were examined for overall sleep disturbance. Bivariate Pearson correlations were conducted to examine relations among age, study group, medication, pain, sleep disturbances, and externalizing and internalizing behavior problem subscale scores. Finally, relations among externalizing and internalizing behavior subscale scores and sleep disturbances were examined with a series of regression models to determine whether externalizing and internalizing behavior subscale scores could be explained by sleep disturbances. All *p* values were two-tailed, and a value of < 0.05 was considered statistically significant.

Results

Demographics

The demographics of the children are presented in Table 1. Average age for the entire sample was 8.5, \pm 1.9 years. Compared to the control group, JIA children were taking more medications ($X^2 = 27.2$, $p < 0.001$), and there was a higher ratio of girls than boys as JIA is more prevalent in females (Table 1).

Parent Report Sleep Disturbances

Table 2 shows significant group differences for parent report of sleep disturbances between JIA and control children. In comparison to control children, JIA children had a higher mean sleep disturbance score. Of the 70 children with a mean sleep disturbance score above the CSHQ cutoff score, 70% ($n = 50$) had JIA with a score of 47.8 ± 6.2 compared to 30% ($n = 21$) of controls with a mean score of 43.6 ± 2.4 .

Behavior Problems

In the entire sample, 7 children (6 JIA) scored above the cut-off score ($T > 63$) for clinically significant internalizing behavioral problems, and only 3 JIA children scored above clinical cut-off score ($T > 63$) for clinically significant externalizing behavioral problems. As seen in Table 3, there were no group differences on CBCL subscale raw scores between JIA and control children. In the entire sample, children with an overall sleep disturbance score >41 (externalizing $46.8, \pm 8.7$; internalizing $49.4, \pm 9.9$) had higher and statistically significant scores for externalizing problems ($t = -2.1$, $p < 0.04$), and internalizing problems ($t = -2.9$, $p < 0.003$) compared to those with an overall score <41 (externalizing $43.4, \pm 7.7$; internalizing $44.4, \pm 7.4$).

Table 1 Demographics.

	JIA (<i>n</i> = 70)	Controls (<i>n</i> = 46)	95% Confidence interval
Age, years	8.5 ± 1.9	8.5 ± 1.8	-.74, .68
Sex, <i>n</i> (%)			
Girls	53 (74%)	30 (65%)	
Boys	17 (26%)	16 (35%)	
Ethnicity, <i>n</i> (%)			
White	59 (86.8%)	30 (62.5%)	
Asian	2 (2.9%)	10 (20.8%)	
Other	7 (10.3%)	6 (17.4%)	
Medications, <i>n</i> (%)			
NSAIDS *	35 (50.7%)	2 (4.3%)	
Corticosteroids *	19 (29%)	0 (0%)	
Disease modifying anti-rheumatic drugs *	37 (52.9%)	0 (0%)	
TNF alpha inhibitors *	12 (17.4%)	0 (0%)	
Other (herbal supplement) *	26 (37.7%)	5 (11%)	
None	8 (11.6%)	39 (85%)	

Data are mean ± *SD* or *n* (%).* Significant between group differences, *p* < .001.

Associations Between Sleep Disturbance and Behavior Problems

Overall mean sleep disturbance score was significantly associated both with externalizing problems ($r = .32$, $p < 0.001$) and internalizing problems ($r = .22$, $p < 0.02$). However, age was inversely associated both with sleep disturbance scores ($r = -.21$, $p < 0.02$) and externalizing behavior problems ($r = -.20$, $p < 0.04$). A series of linear regression models were conducted to assess the contribution of sleep disturbance to the explained variance in the

Table 2 CSHQ Subscales between JIA and control children.

CSHQ subscales	JIA group (<i>n</i> = 68) <i>M</i> (<i>SD</i>)	Control group (<i>n</i> = 46) <i>M</i> (<i>SD</i>)	<i>p</i> value
Bedtime resistance	7.8 ± 2.2	7.5 ± 1.8	0.57
Sleep onset delay	1.6 ± 0.7	1.2 ± 0.4	0.001
Sleep duration	4.0 ± 1.4	3.7 ± 1.1	0.17
Sleep anxiety	5.8 ± 2.0	5.0 ± 1.4	0.017
Night wakings	4.0 ± 1.3	3.3 ± 0.7	0.001
Parasomnias	9.3 ± 1.8	7.9 ± 1.1	0.001
Sleep disordered breathing	2.3 ± 0.6	2.1 ± 0.4	0.03
Daytime sleepiness	12.9 ± 3.5	11.0 ± 3.3	0.004
Total Sleep Disturbance	45.0 ± 7.3	39.1 ± 4.9	0.001

Data are mean ± *SD*.**Table 3** CBCL scores between JIA and control children.

	JIA group (<i>n</i> = 68) <i>M</i> (<i>SD</i>)	Control group (<i>n</i> = 46) <i>M</i> (<i>SD</i>)	<i>p</i> value
CBCL subscales			
Externalizing behavior	46.0 ± 9.1	44.8 ± 7.4	0.45
Internalizing behavior	47.9 ± 9.5	46.8 ± 9.2	0.53
Total problems	45.8 ± 10.0	43.9 ± 8.96	0.30

Data are mean ± *SD*; *p* < 0.05.

externalizing and internalizing behavior subscale scores. Because significant correlations were found among sleep disturbance, age, study group, medications, and pain these variables were entered in the first step and second steps; overall sleep disturbances was entered in the third step (Table 4).

In the first regression model testing predictors of the dependent variable externalizing behaviors problems, study group, medications and overall sleep disturbances accounted for 7% of the variance ($F(5,106) = 6.1$, $p < 0.001$). In the second regression model testing predictors of the dependent variable internalizing behavior problems, sleep disturbance was the only significant predictor ($p < 0.02$), however the overall model was not significant ($F(5,106) = 1.5$, $p = 0.20$), after controlling for confounding variables.

Table 4 Predictors of total behavioral problems.

Variable	Unstandardized		
	β	SE β	Standardized β
Model 1: ^a			
Externalizing behavior problems			
Step 3			
Age	-0.02	0.02	-0.11
Study group (ref = 0)	0.20	0.08	0.33
Medication (ref = 0)	-0.29	0.08	-0.48
Pain	-0.02	0.02	-0.01
Sleep disturbances	0.02	0.01	0.34
Model 2: ^b			
Internalizing behavior problems			
Step 3			
Age	0.05	0.03	0.17
Study group (ref = 0)	-0.02	0.15	-0.02
Medication(ref = 0)	0.02	0.14	0.02
Pain	-0.04	0.04	-0.11
Sleep disturbances	0.02	0.01	0.28
R ² change = .06			

^a *n* = 105, $F(5,106) = 6.1$, $p < 0.001$.^b *n* = 105, $F(5,106) = 1.5$, $p = 0.20$.

Discussion

Findings from this study show that while parents report disturbed sleep in their children with JIA, the scores for behavior problems were similar to those for typically developing children. Compared to typically developing children, total sleep disturbance score and subscale scores for sleep onset, sleep anxiety, night awakenings, parasomnias, sleep disordered breathing, and daytime sleepiness were greater in children with JIA. These findings are consistent with previous studies that used the same sleep questionnaire in JIA (Bloom et al., 2002; Butbul Aviel et al., 2011; Bromberg, Gil, & Schanberg, 2012b). Although group differences for behavior problems were not found, total sleep disturbance score was a significant predictor of externalizing behavior problems but not internalizing behavior problems.

Sleep disturbances were predictive of externalizing behavior problems after controlling for age, study group, medications, and pain. These findings are similar to previous research on typically developing peers (Bonuck, Freeman, Chervin, & Xu, 2012; Gregory & Wiggs, 2013; Ruperto et al., 2010; Touchette et al., 2007). Externalizing behaviors of aggression, hyperactivity, and impulsivity may be easier for parents to recognize versus internalizing behaviors that are not always overt. Poor sleep may impact children's self-regulatory skills thus they have more difficulty following directions, controlling their behaviors, and responding to social demands at home and at school. Several longitudinal studies by Gregory and colleagues found that sleep problems in typically developing children during the preschool years predict behavior problems of anxiety, attention problems, aggression, and depression in middle school and adolescence (Gregory, Caspi, Moffitt, & Poulton, 2009; Gregory, Caspi, Moffitt, & Poulton, 2009). These findings suggest disturbed sleep in early childhood may be a risk factor for behavioral problems in later years, and supports the need to assess and treat sleep problems in early childhood. To our knowledge, there are no known longitudinal studies that examine the trajectory of sleep disturbances as predictors of anxious and aggressive behaviors in JIA children from preschool to middle school years.

In the present sample, sleep disturbances explained a small amount of variance in internalizing behavior problems; however the overall model was not significant. This finding may be attributed to particular child characteristics (i.e., temperament), low pain levels and mild disease severity, and the measure of anxiety. Additionally, the CHSQ questionnaire includes items addressing both behavioral sleep disturbances (i.e., bedtime resistance, sleep onset delay, parasomnias) and sleep disorders (i.e., sleep disordered breathing, daytime sleepiness) versus distinct sleep constructs. Previous studies report associations between more disturbed sleep including trouble falling asleep and bedtime resistance, and more anxious/withdrawn behavior (Gregory et al., 2005; Pesonen et al., 2010; Touchette et al., 2012). It is possible that children who experience anxiety may have

more difficulty falling asleep, and delay going to bed by engaging in bedtime activities such as watching television or playing games on the computer.

Contrary to our hypothesis, we anticipated that parents of JIA children would report more behavior problems since their children had more disturbed sleep in comparison to typically developing children. However, the parents in the present study reported similar scores to those from previous studies that examined externalizing and internalizing behaviors in JIA compared to their peers (LeBovidge et al., 2003; Noll et al., 2000). These findings may reflect differences in parental perception of "disruptive or problematic behavior". Parents caring for children with chronic conditions have to cope and manage their child's chronic condition, and this may influence parents' interpretation of what constitutes a "disruptive or problematic behavior". For example, parents may attribute anxiety, withdrawal, or aggression to disease-related symptoms of pain and fatigue or side effects of medications. Anxiety or aggression may also be interpreted as a child's way of coping, and some parents may be empathetic and not view a particular behavior as problematic.

Limitations

There are several limitations worth noting in this study. First, the cross-sectional design limits directionality, as all the associations are potentially bidirectional. Second, parents may have perceived sleep as a problem for their child and may have been more willing to participate in this study. Third, we relied solely on parent reports of behavior problems rather than including an additional report from a neutral third party, such as teachers. Lastly, we did not have an equivalent number of control children for comparison, and this may contribute to our findings. Future studies incorporating repeated measures design with objective measures of sleep and parent and teacher report of behaviors as well as assessment of fatigue, and cognitive performance may provide additional knowledge about the impact of disordered sleep in these children.

Clinical Implications

The adverse consequences of untreated sleep disturbances and sleep disorders are a public health concern associated with increased health care costs (Tarasiuk & Reuveni, 2013), neurobehavioral deficits (poor school performance, inattentiveness, slow reaction time) (Beebe, 2006; Smaldone, Honig, & Byrne, 2007), daytime sleepiness (Ward et al., 2010), and cardiovascular morbidities (Narang et al., 2010; Whitmans & Young, 2011). Sleep disturbances such as sleep onset delay and daytime sleepiness, or sleep disorders such as sleep disordered breathing and periodic limb movements in children with chronic conditions may be overlooked or

unrecognized in clinical care, likely because the comorbidity of sleep disorders in chronic conditions are not well understood. Sleep onset delay, daytime sleepiness, and sleep disordered breathing may be attributed to disease-related symptoms of pain and/or medications rather than an underlying sleep disorder. Findings from previous studies suggest that sleep disturbances in JIA children may stem from underlying sleep disorders such as sleep disordered breathing and periodic limb movements rather than disease-related symptoms (Abad et al., 2008; Passarelli et al., 2006; Ward et al., 2010). For example, a recent study from our laboratory found 40% of a sample of school age children with JIA had an elevated apnea-hypnea index of $>1.5/\text{hour}$, indicative of sleep disordered breathing (Ward et al., 2010). Importantly, at the time parents and clinicians were unaware of the child's sleep disturbances and the majority of children were not asked about their sleep.

Assessment of sleep disorders that are related to chronic conditions such as JIA is complex due to the bidirectional relationship between the underlying disease condition and sleep (e.g., pain leads to poor sleep or poor sleep leads to pain). It is challenging for clinicians to discern the cause and effect relationships, thus both the sleep disturbance and chronic condition need to be simultaneously addressed. Routine sleep assessments are an important area for clinicians caring in children with JIA or other chronic health conditions. Sleep assessment includes a thorough sleep history, addressing quantitative and subjective characteristics of sleep and sleep disturbances; related factors and consequences (e.g., behavior, mood, fatigue, excessive daytime sleepiness); a thorough medical, psychiatric, developmental, and social health history; medication history; physical examination; laboratory testing where indicated; and depending on the nature of the suspected sleep disorder, specialized sleep testing in a certified pediatric sleep laboratory setting. Specific sleep assessment methods used in clinical practice include sleep diaries, questionnaires, and objective measures (e.g., wrist actigraphy, polysomnography) of specific sleep characteristics. The impact of sleep disorders (e.g., sleepiness, cognitive function, and school performance) should also be assessed.

Conclusions

Recent reviews highlight the need for additional research on the prevalence of sleep disorders, specifically sleep disordered breathing in JIA (Abad et al., 2008) and the impact of sleep disorders on health outcomes (Owens & Mindell, 2006). Sleep disordered breathing may be an additional burden for children with JIA and their families. Compared with healthy children, children with JIA require more specialized health care, medical costs are generally higher, and they are more likely to miss days from school and require special education services (Bernatsky et al.,

2007; Minden, 2006). Missed days from school and lower quality of life in JIA often are attributed to pain and fatigue, but sleep disorders including sleep disordered breathing actually may be an important etiology that is unrecognized by both clinicians and parents. Anticipatory guidance regarding sleep hygiene may not only improve sleep, it may also improve health outcomes including daytime functioning (i.e., neurobehavioral emotional functioning, school performance, peer interactions) and quality of life. Given the public health concerns of sleep disorders it is important for clinicians to consistently assess sleep habits and sleep disturbances in children with JIA, as well as incorporate a routine sleep assessment for all children with chronic conditions.

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